1. Electrons in a certain oscilloscope travel a horizontal distance of 40 cm before hitting the screen of the scope. The point of impact with the screen is deflected 1.0 cm by the earth's magnetic field when the electrons are "fired" eastward. (a) In what direction are the electrons deflected? (b) Determine the speed of the electrons assuming the earth's field is 0.50 G northward. (c) What is the voltage difference between the two plates of the electron gun in this oscilloscope?

2. An electron has speed 2.0×10^6 m/s and moves perpendicular to a uniform magnetic field of 4.5×10^{-5} T. (a) Determine the radius and period of its motion. (b) Repeat for a proton with the same speed.

3. Suppose the electron in the previous problem is not moving perpendicular but rather at an angle of 30.0º relative to the field. What is the resulting motion?

4. In the *e*/*m* device shown below electrons are linearly accelerated by a certain potential V and then centripetally accelerated by a uniform magnetic field B.
(a) Solve for *e*/*m* in terms of V, B, and r.
(b) If $V = 250$ V and $B = 1.0$ mT find r.

5. In certain atomic particle experiments it is necessary to isolate particles with particular speed. This may be accomplished by perpendicular electric and magnetic fields. Only charged particles with a certain velocity can pass through the fields in a straight line. Make a sketch and determine the velocity in terms of E and B.

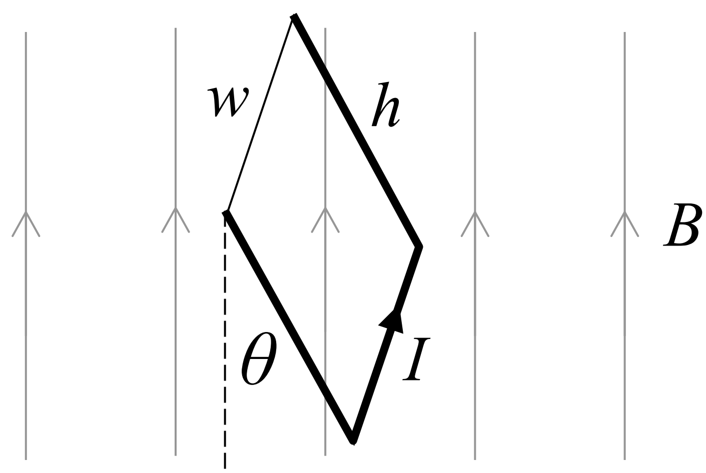
6. Lithium isotopes are found at $R = 2.93$ cm 2.51 cm, 1.46 cm, and 1.25 cm in a Bainbridge mass spectrometer with $E = 17\underline{0}$ kV/m and $B = 0.650$ T. Determine the masses of the isotopes.

7. A cyclotron used to accelerate alpha particles has an outer radius of 0.50 m and a magnetic field of 1.8 T. (a) Determine the time for an alpha to complete a semicircle in the device. (b) What is the maximum speed of the alpha particles? (c) What is the maximum kinetic energy of the alpha particles in eV?

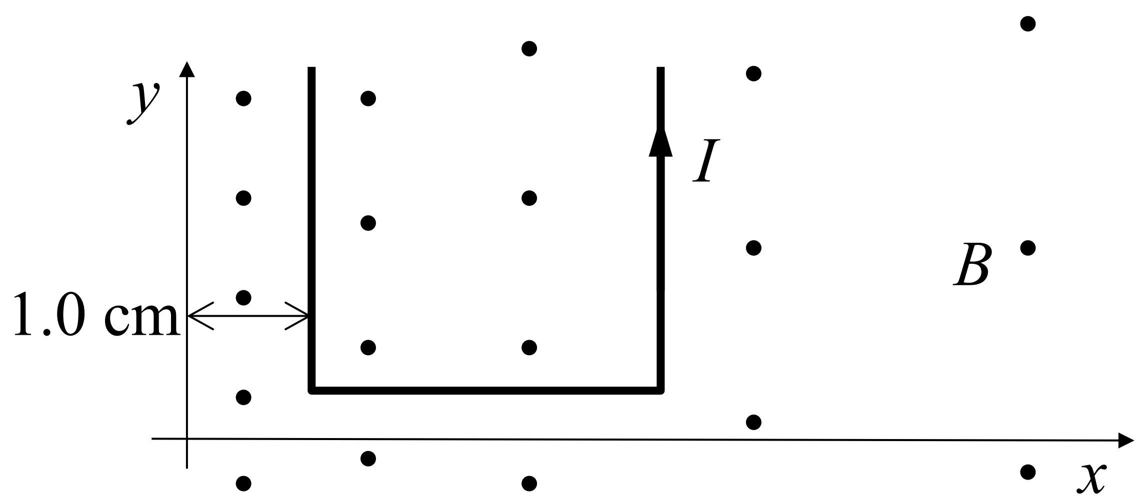
8. A power line stretches 60 m between poles and carries a westward current of 150 A (ignore sagging of the line). Take earth's field to be 0.50 G north and determine the force on this section of wire. Repeat, supposing the current is running toward the southeast.

9. A section of wire 2.0 cm long is placed in a horizontal magnetic field of 6.0 mT, 90.0 ° (north). Find the force on this section of wire if it carries a current of 3.0 A, 0.0° (east). Repeat for current 10.0 A, 160.0°.

10. A wire "swing" of mass m has width w and height h. When current I passes through the wire in the presence of a vertical magnetic field B the wire rests at an angle θ relative to vertical as shown below. (a) Solve for B. (b) Find the angular acceleration if swing is vertical.

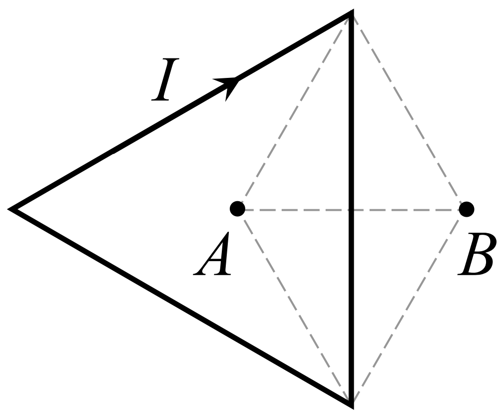


11. As shown below, a wire "U" with current 3.0 A is placed in a magnetic field **B** = 0.015/*x* **k**, where *B* is in tesla and *x* is in meters. Determine the net magnetic force on the "U", each side of which is 3.0 cm.



12. A rectangular coil of wire has dimensions 1.50 cm × 2.00 cm and consists of 30.0 turns. This coil carries 5.00 A and is placed in a uniform vertical magnetic field of 80.0 mT. (a) Determine the torque on the coil if it is located in a vertical plane. (b) Repeat if the plane is tilted 20.0° from vertical.

13. A current I flows in a triangular loop of sides L as shown in the figure. Find the magnetic field at points A and B. (The dashed triangles are equilateral.)



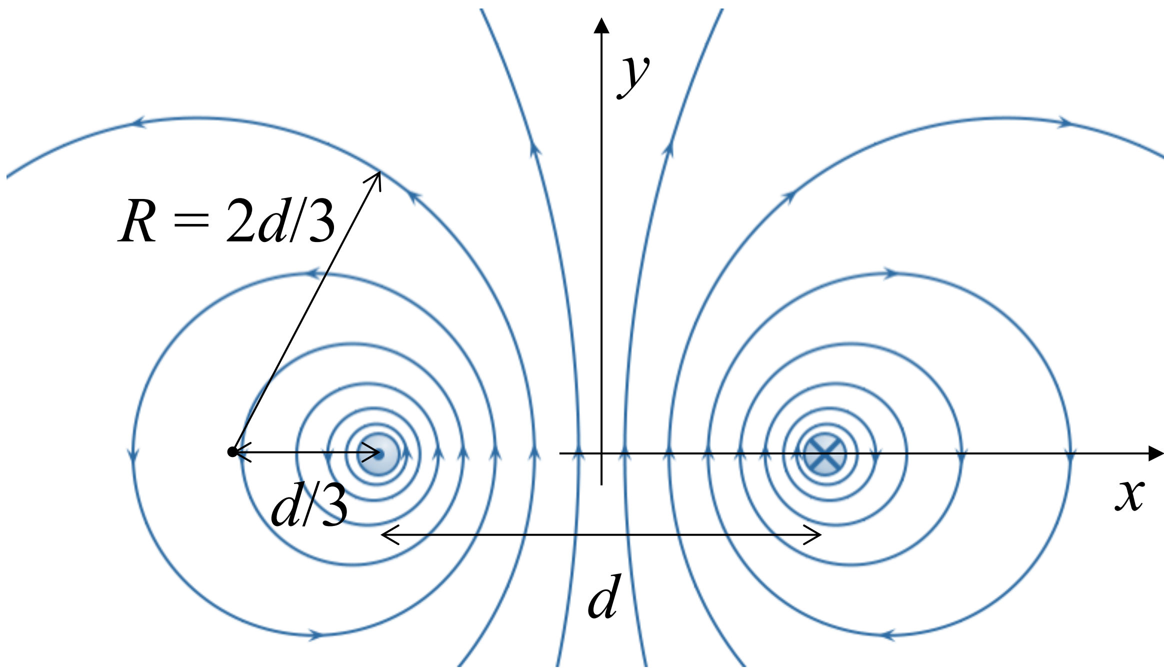
14. A current I flows in a circular loop of wire with radius R. (a) Find the magnetic field at the center of the loop. (b) Find the magnetic field at a distance r along the axis of the loop.

15. Determine the magnitude of the magnetic field at the exact center of a regular hexagon of side L carrying a current I.

16. A wire of length L stretches north and south across a table. A compass is placed a distance h directly above the center of the wire. The compass deflects θ when the wire has current I north. (a) In what direction is θ? (b) Find the horizontal component of Earth's magnetic field.

17. Derive an expression for the magnetic field within and without a long straight wire or radius R carrying current I. What is the maximum field strength for a wire of diameter 1.3 mm carrying current 5.0 A?

18. Derive an expression for the magnetic field strength $B(y)$ along a perpendicular bisector of antiparallel currents of amount I. Show that Ampere's Law holds for a path surrounding only <u>one</u> of the two currents.



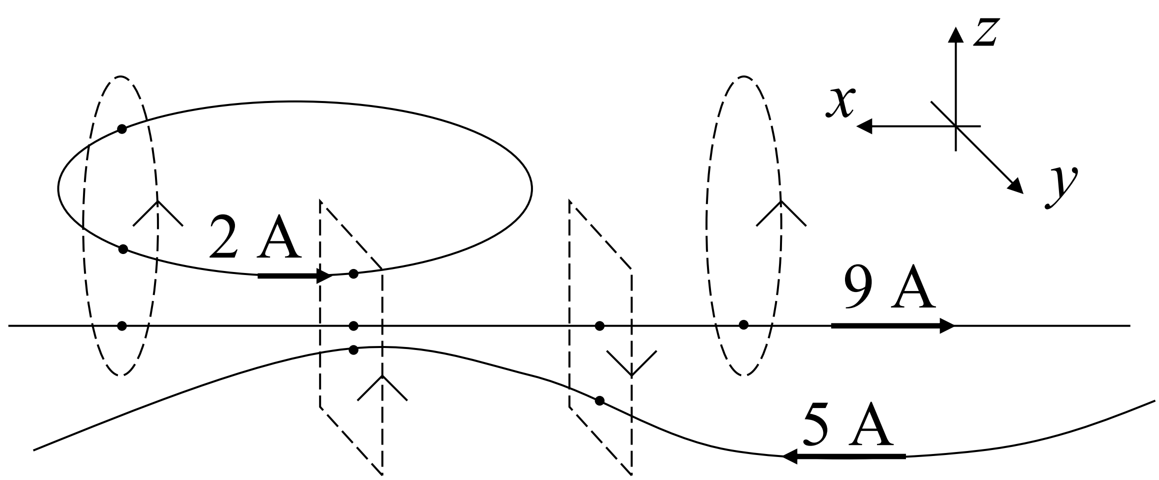
19. Refer to the diagram above – use Ampere's Law to determine the average field strength along the circle of radius R – compare to the geometric mean of the minimum and maximum that occurs along the circle.

20. A typical lamp cord consists of two wires separated by 3.0 mm center to center. If the cord carries 0.50 A, determine the force per length and describe as repulsion or attraction. If the cord is 1.50 m long, what is the total force on one of the wires?

21. Suppose each wire of the cord in the previous problem has a diameter of 1.00 mm. Determine the magnetic field strength at points: (a) halfway between, (b) along an "inner" surface of one wire, (c) along an "outer" surface of one wire.

22. Two circular coils of radius R and N turns each carry a current I. The currents run parallel to one another and are separated by distance r. Derive an approximation for the force each coil exerts on the other.

23. Use Ampere's Law to determine the result of integrating **B**·**dl** along each of the paths shown in the diagram. Each current is in the *xz* plane, each path is parallel to *yz* plane.



24. Determine the magnitude of force acting on two *finite* sections of parallel wires of length L separated by distance r carrying currents I_1 and I_2. In what relative directions must the currents be in order for the two wires to attract?

25. Show that the force per length approaches the expected result as the discrete lengths of the wires in the previous problem each approach infinity.